

## CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of International Patent Application No. PCT/JP2004/016727, filed November 11, 2004, which claims priority of Japanese Patent Application No. 2003-383772, filed November 13, 2003.

## TECHNICAL FIELD

This invention relates to an adjustable interdental brush with a cap that can be attached and detached regardless of the brush body angle.

## BACKGROUND

The interdental brushes generally known and used consist of a handle and a brush body formed of a thin metal wire strand folded and twisted wherein a filament is captured between the wire. The brushes are generally cylindrical or cone-shaped and the handle is generally synthetic and often cylindrical of appropriate size to hold in the hand. A wire base of the brush body is often fixed onto the handle using methods such as insert molding and other physical joining methods including thermal fusion by high frequent and ultrasonic waves to integrate the brush body with the handle.

The problem with such conventional interdental brushes is that the base was often bent to fit into the gap between

teeth to insure the best angle between the handle member and the brush. Repeating this procedure will damage the wire quite easily in a fairly short time period.

As a proposed solution, some interdental brushes have a handle, and a brush support member to fix and hold the brush body, with the tip of the handle branched in two on which the brush support member is pivotally supported in a freely rotating manner. (See Kokai Disclosure No. 9-121942 (Patent Document 1)). However, such interdental brushes have the problem of increased manufacturing costs due to the increased number of parts necessary to make the brush support member.

Another type of interdental brush has been proposed in which the handle is made of two sub-handles, right and left sub-handles symmetrically centered on a common axis to form one handle, with the tip of both sub-handles fixed via five rings with a wire support. (See Kokai Application No. 8-508179 (Patent Document 2)).

The interdental brush shown in Patent Document 2 adjusts the angle of the brush body against the handle by sliding the right and left sub-handles in the direction of the handle by which operation the cleaning action is enhanced. By forming the handle member so that these two sub-handles can open at an angle of  $180^{\circ}$ , the handle can be formed in one process whereby the number of parts and costs incurred are reduced.

Patent Document 1: Kokai Disclosure No. 9-121942

Patent Document 2: Kokai Application No. 8-508179

## SUMMARY

However, the problem with the interdental brush shown in Patent Document 2 lies in the fact that the handle member must be cast with the two sub-handles in the open position. This requires the surface area of the mold to be more than twice as large as that required for a conventional handle, negatively impacting productivity of manufacture. Moreover, to make a handle a convenient length to hold, a large mold is required, resulting again in increased cost. In addition, as this toothbrush adjusts the brush body by sliding the sub-handles, it is not easy to use due to the potential risk of accidentally sliding the sub-handle while using the interdental brush. As a result, interdental brushes made this way are generally small in size and hard to use.

Here, an adjustable brush, which is easy-to-handle, cost-competitive and has a cap attachable to the brush regardless of its angle is disclosed.

The interdental brush which meets the above requirements is one having a brush body and a handle member. The handle member consists of a handle, an arm extending from one end of the handle along the length of the handle, a brush support that holds the base of the brush body, a first hinge that connects the tip of the arm and one end of the brush support in a freely rotating manner, an operating portion situated in a position-

changeable manner at the other end of the handle member and slidable along the length of the handle, and a second hinge that connects the tip of the operating portion and the other side of the brush support in a freely rotating manner. Changing a position of the operating portion along the handle's length enables the user to rotate the brush body about the hinge.

The interdental brush may have a cap comprising a cap body covering the entire brush body, a cap base that is removably attachable to the brush support, and an opening formed by the cap base and cap body to cover the brush and the brush support. The cap preferably has an opening extending the length of the cap body and cap base to cover the entire brush body and brush support from the back.

When the operating portion of the interdental brush has a sliding portion at the other end of the handle member that moves along the length of the handle, and when the above-mentioned position changing is done by sliding, moving the slide gives an optimum angle for the brush body depending on the gap between the teeth. This movement can be done easily and in a stable manner while holding the handle, with or without attaching the extension pipe. Thus, the operational performance of the interdental brush can be improved by fitting its brush angle to the gap between the teeth.

Adding the position support means between the handle and the operating portion to keep the brush support at first and second positions centered on the first hinge can hold the brush at these switch-over positions, giving stability of the brush while cleaning, and hence, the operation of the brush can be enhanced by adjusting the brush angle to the optimum position.

Connecting the tip of the arm to one end of the brush support via the first hinge and the tip of the operating portion and the other end of the brush support via the second hinge can hold the brush support at the alternative two positions centered on the first hinge, and the position of the brush body is stabilized while in operation and hence the operational performance of the brush is enhanced. In other words, for example, depicting the brush support as a square will locate both hinges at the ends of the diagonal line of the brush support, giving a distance between both hinges larger than that for the end-to-end length of the brush base. Thus, sliding the operating portion will generate a large slide friction due to the sideways movement, resulting in the operating portion being easy to hold at either of the two positions, and the brush support to be held in the two switch-over positions.

The cap for the interdental brush comprises a cap body covering the entire brush and a detachable cap base that fit onto the brush body and brush support from the back.

Thus, the cap fits quite easily and safely onto the brush body and brush support of the brush using the opening in the cap body and cap base. This is a benefit for elderly people with poor eyesight. In addition, because the cap is fitted to the brush support, the brush body angle can be adjusted easily and sanitarily while the cap is on it without using bare hands. Because the cap can be fitted to the toothbrush while holding the brush body at any angle, the brush can be stored while the brush body is disposed at any angle relative to the handle.

References to directions (e.g., left/right, up/down) refer to the orientation within the various figures shown herein and are for convenience only. They should not be used to limit the invention.

The productivity of manufacture of this interdental brush is increased and its cost reduced, as the handle, arm, brush support, operating portion, and hinges are integral parts of the handle member and can be molded in one process using synthetic resin. In addition, the handle length can be adjusted, making it convenient to hold by changing its size and by adding an extension pipe to form the handle of the brush. As it does not require opening the handle members to 180 degrees, unlike the brush shown in Patent Document 2, it does not require a large mold and hence, an easy-to-handle brush can be manufactured quite cost-effectively. Moreover, by adjusting the position of

the operating portion along the length of the handle, an optimized angle of the brush body can be obtained to fit in the gaps between teeth and cleaning performance can be improved. Also, operation of the interdental brush can be improved, as it allows to hold stably the handle or the extension pipe connected thereto by hand.

The cap for this interdental brush can fit the brush body and brush support with the cap body and cap base using the opening from the side, so that the cap can be attached to the brush for storage, whatever the angle of the brush body. Hence, the operation of attaching and detaching the cap from the toothbrush as well as the ease of storage with the cap attached can be enhanced. As the cap is held at the brush support, the brush angle can be adjusted with its cap on without touching the brush with bare hands, and the sanitary condition of the brush is maintained.

#### BRIEF DESCRIPTION OF DRAWINGS

Fig. 1(a) is a front elevational view of the interdental brush; Fig. 1(b) is a right side elevational view of the interdental brush of Fig. 1(a).

Fig. 2(a) is a cross-sectional view through line A-A of Fig. 1 (b); Fig. 2(b) is a cross-sectional view through line B-B of Fig. 1(a).

Fig. 3(a) is a partial perspective view of the tiltable support; Fig. 3(b) is a partial perspective view of the operating portion.

Fig. 4 is a front elevational view of the interdental brush at the second position.

Fig. 5(a) is a partial front cross-sectional view of a second embodiment of the interdental brush; Fig. 5(b) is a right side elevational view of the interdental brush of Figure 5(a).

Fig. 6(a) is a front elevational view of a third embodiment of the interdental brush at the first position; Fig. 6(b) is a front elevational view of the interdental brush of Fig. 6(a) at the second position.

Fig. 7(a) is a partial front cross-sectional view of the cap and the interdental brush at the first position; Fig. 7(b) is a cross-sectional view through line C-C of Fig. 7(a); Fig. 7(c) is a right elevational view of the cap; and Fig. 7(d) is a partial front cross-sectional view of the cap and the interdental brush at the second position.

#### DETAILED DESCRIPTION

##### Listing of Reference Numbers:

- 1 Interdental brush
- 2 Brush body
- 3 Handle member
- 4 Wire

- 5 Brush
- 6 Handle body
- 10 Tilttable support portion
- 12 Arm
- 13 Brush support
- 14 First hinge
- 15 Operating portion
- 16 Second hinge
- 20 Slide guide
- 21 Stop
- 22 Cutout
- 23 Control portion
- 1A Interdental brush
- 3A Handle member
- 6A Handle body
- 15A Operating portion
- 30 Hole
- 31 Guiding plate
- 32 Slide hole
- 33 Engagement portion
- 34 Wider hole
- 1B Interdental brush
- 3B Handle member
- 6B Handle body
- 15B Operating portion
- 35 Recessed portion

- 36 Protrusion
- 50 Cap
- 51 Cap body
- 52 Cap base
- 53 Opening
- 54 Protrusion
- 55 Recessed portion

As Figure 1 shows, the interdental brush 1 is comprised of the brush body 2 including the brush 5 and the wire 4, and the handle member 3 supporting the brush body.

The brush body 2 shown in Figures 1 and 2 is made of thin wire 4 strands folded and twisted, and filaments captured radially by the wire 4, in a well-known configuration. The profile of the brush 5 can be either cylindrical or conical. It can also be barrel-shaped with the outer diameter of the middle portion of the brush larger than that of the top or the bottom of it. The brush body 2 and handle can be made by a one-shot molding of synthetic resin, including the brush and its core support.

As Figures 1 to 4 show, the handle member 3 comprises a elongated handle 6 of appropriate size to hold in the hand and a tiltable support portion 10 attached to the upper end of the handle 6. The brush body 2 is connected to the handle 6 in a freely movable manner by way of the tiltable support portion 10. The handle member 3 is made

of synthetic resin having a property capable of withstanding repeated bending of an integrally formed hinge and enough strength to serve as a handle, such as polyethylene, polypropylene or thermoplastic elastomer, and the handle member 3 is formed by one-shot molding by a method such as injection molding.

As shown in Figures 1(a) and 2(a), the tiltable support portion 10 consists of an arm 12 extending upward from the left end (one side at the tip) of the upper, roughly even surface of the handle 6, a brush support 13 with the bottom (the proximal end) of the wire 4 of the brush body 2 fixed therein, a first hinge 14 connecting the upper end of the arm 12 and left bottom end of the brush support 13 which rotate freely with respect to each other, an operating portion 15 at the right side (other side) of the handle member 3 in a manner that is freely slidable along the length of the handle 6, and a second hinge 16, comprising an integrally formed hinge, that connects the upper end of the operating portion 15 and the right upper end of the main body of the brush support 13 in a freely rotating and movable manner. The position of the brush support 13 is supported in a range of about 90 degrees centered on the first hinge 14 in a freely rotating and movable manner by operating the operating portion 15 upward or downward, between in a first position in Figure 1(a) with the brush body 2 directed upward or downward and in a

second position in Figure 4 with the brush body 2 directed left or right direction.

As Figure 1 shows, the L1 length between the proximal end of the arm 12 and the first hinge 14 is almost equal to or slightly longer than the L2 length between the right end of the bottom of the brush support 13 and the first hinge 14. The L3 length between the bottom of the brush support 13 and the second hinge 16 is almost equal to or slightly longer than the L4 length between the right end of the handle 6 and the arm 12. In addition, the upper surface of the handle 6 and the right surface of the arm 12 almost form a right angle. The same is true in the case of the angle between the lower surface of the brush support 13 and the right surface of the brush support 13. When the brush support 13 is in the first position shown in Figure 1(a), the angle between the lower surface of the brush support 13 and the right surface of the arm 12 is almost at a right angle, whereas when the brush support is in the second position shown in Figure 4, the lower surface of the brush support 13 is almost in contact with the right surface of the arm 12 (the lower side in Figure 1) and the bottom surface of the brush support 13 is almost in contact with the upper surface of the handle 6 (the lower right side in Figure 1). In addition, in this second position, the second hinge 16 moves closer to the right end of the upper surface of the handle 6.

In this embodiment, the lengths and angles described above are for the purpose of enabling the rotation of the brush body 2 between the first and second positions shown in Figures 1(a) and 4 over a range of rotation of approximately 90°. However, the range of rotation of the brush body 2 can be altered by changing these lengths and angles.

In order to enable the operating portion 15 to slide only upward and downward freely along the handle 6, a pair of slide guides 20 is formed extending along the upper handle 6. A pair of stops 21 are formed on the opposite sides and at the lower end of the operating portion 15 to slidably grip and fit into slide guides 20. The operating portion 15 is thus slidably fitted to the handle portion 6 with the stops 21 freely movable in the slide guides 20.

The front and the rear stops 21 are not disposed directly opposite each other, but are staggered a distance in an upward and a downward direction with respect to each other as are the front and the rear slide guides 20 in order to accommodate the stops 21 so that the handle member 3 can be molded by a pair of molds. It is possible to locate the stops 21 and slide guides 21 symmetrically in the front and the rear direction with respect to the handle 6, though this would require slightly different molding configurations.

Cutouts 22 are formed in each of the upper and the lower portion of the slide guides 20, and the operating portion 15 can be fit onto the handle 6 by engaging the front and the rear stops 21 through the cutouts 22 into the slide guides 20 one after another, using the elasticity of the operating portion 15. The control portion 23 is located between the upper and lower cutouts 22 which blocks the movement of the operating portion 15 downward by engaging the control portion 23 with the base of the stops 21, when the brush body 2 is at the first position by moving the operating portion 15 upward, and which blocks the movement of the operating portion 15 upward by engaging the control portion 23 with the base of the stops 21, when the brush body 2 is at the second position by moving the operating portion 15 downward. To move the operating portion 15 from the upper position to the lower position, or vice versa, the operating portion 15 should be forced to push upward or downward against the elasticity of the material beyond the control portion 23 to move the stops 21 to upper or lower cutouts 21. A position maintaining means of the interdental brush 1 is structured by the cutouts 22, control portion 23 and stops 21.

The interdental brush 1 is designed so that moving the operating portion 15 upward will make the brush body 2 and the brush support 13 rotate to the first position as shown in Figure 1 about the first hinge 14, whereas moving the

operating portion 15 downward will make the brush body 2 and the brush support 13 rotate to the second position about the first hinge 14. By rotating the position of the operating portion 15, cleaning can be done by changing the position of the brush body 2 to best suit the gap between the teeth. When the brush body 2 is in the first or second positions, the stops 21 on the operating portion 15 will engage the control portion 23 and cleaning can be done by stabilizing the brush body 2 at the appropriate position. The frictional engagement of the stops and slide guides is such that there is sufficient resistance that the angle of the brush body does not readily change during use, but the angle can be readily changed by the user. The ridges shown on operating portion 15 provide a tactile way for the user to overcome the frictional engagement and change the angle.

In the preferred embodiment, an interdental brush 1 with a handle 6 of appropriate length for ease of handling is provided. However, other battery-driven interdental brushes or other handles can be used by adding a short detachable extension pipe, and the brush can substitute for any other battery-driven interdental brush. Here, the brush body 2 is permanently fixed to the handle member 3 by embedding a wire 4 in the brush support 13. However, it is also applicable to a system in which the brush body 2 can be replaced. It's also possible to engage a brush

integrally formed with a brush body and a brush support to a handle member by using stops means.

In another embodiment, as shown in Figure 5, the interdental brush 1A has a handle member 3A with an elongated hole 30 extending through the front and rear sides of the body at the upper right of the handle 6A. A guiding plate 31 is attached at the right of the hole 30. A narrow slide hole 32 in the middle of the guiding plate 31 is in communication with hole 30 to accept the engagement portion 33 that protrudes from the free end of the operating portion 15A. Wider holes 34 are located at the upper and lower ends of the slide hole 32. In this embodiment, when the engagement portion 33 is fitted into the upper large hole 34, the brush body 2 together with the brush support 13 is kept in the first position. When the engagement portion 33 is engaged in the lower large hole 34, the brush body 2 together with the brush support 13 is kept at the second position. Moving the operating portion 15A upward and downward will move the engagement portion 33 through the narrowed portion of the slide hole 32 to move to the upper or lower large holes 34 to keep the brush body 2 at the first or second positions changeably.

In another embodiment, the handle member 3B of the interdental brush 1B as shown in Figure 6, has more than one recessed portion 35 in the shape of, for example, a dovetail groove. The recesses 35 are located at intervals

along the upper right surface of the handle 6B to receive the protrusion 36 on operating portion 15. When the protrusion 36 is engaged in one of the recesses 35, the brush 2 is held in the first or second position. To rotate the brush 2, the protrusion is disengaged from the recess and the operating portion 15 is moved so that the protrusion 36 is engaged with the other recess 35. Any number of recesses 35 can be formed in the handle 6B to hold the brush 2 in a plurality of different positions.

In this embodiment, the brush body 2 is structured in a position-changeable manner between the first and the second position by moving the operating portions 15, 15A and 15B upward or downward. But it's also possible to make a structure capable of being changed in a plurality of positions, more than one.

The cap 50 can be used for interdental brush 1, 1A and 1B, as well as other types of interdental brushes. As Figure 7 (a) shows, the cap 50 consists of a cap body 51 that covers the entire brush body 2 and a cap base 52 that engages the brush support 13. An opening is provided at the right side of the cap body 51 so that the cap 50 may be placed over the brush 2 and brush support 13.

As Figures 7 (b) and (c) show, long thin protrusions 54 are formed on the front and rear opposite sides of inner surface of the cap base 52. The front and rear sides of the brush support 13 are provided with recessed portions 55

to receive the protrusions 54. The cap 50 is fitted to the brush support 13 by engaging the protrusions 54 with the recessed portions 55 so that the cap may be attached and detached from the brush support 13. The cap 50 thus may cover the entire brush body 2 and the brush support 13. Alternatively, a hook system can be used to engage the cap base 52 to the brush support 13.

The cap 50 can be fitted to the interdental brush 1 while holding the brush body 2 and the brush support 13 in the first position as shown in Figure 7 (a) or the second position as shown in Figure 7 (d) and the interdental brush 1 can be stored in these respective positions with the cap 50 on. Therefore, the ease of fitting the cap 50 onto the interdental brush 1 and the ease of storing the interdental brush 1 with the cap 50 on is significantly enhanced. In addition, as the cap base 52 engages the brush support 13 to fix the cap 50 to the brush support 13, the angle of the brush body 2 is adjustable while the cap 50 is on, to maintain sanitary conditions without touching the brush body 2.

The embodiments described above and illustrated in the figures are presented by way of examples only and not intended as a limitation upon the concepts and principles of the present invention. As such, it will be appreciated by one having ordinary skill in the art that various changes in the elements and their configuration and

arrangement are possible without departing from the spirit and scope of the present invention.